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Infectious diseases that can occur after an earthquake: a review

Ayşegül Tuna

Department of Infectious Diseases and Clinical Microbiology, Faculty of Medicine, Kırıkkale University, Kırıkkale, Turkey

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Corresponding Author: Ayşegül Tuna, draaslan87@gmail.com

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ABSTRACT

Due to uncontrolled urbanization and rapid population growth, earthquakes can have major effects on human life, society and economic systems. Infectious diseases can be seen depending on the factors that facilitate the development of infection in the long term after earthquakes. Lack of clean water, food and hygiene are important causes of infectious disease for individuals. Problems in the city's mains systems such as water and electricity are also among the reasons that increase the possibility of infectious disease. Lack of adequate medication may cause delays in treatment. For this reason, the surveillance of infectious diseases, which increased after the earthquake, has an important place in the fight against infectious diseases and epidemics. Earthquakes can lead to an increase in latent infections such as skin and soft tissue infections, gastroenteritis caused by contaminated food and water, respiratory system infections transmitted by droplets, rash diseases, meningitis, and tuberculosis due to limited treatments.

Keywords: Earthquake, infection disease, precaution

INTRODUCTION

Earthquakes are natural events that occur at depths of several kilometers under the earth's crust and can be devastating at the epicenter, however the number of earthquakes that cause damage are very few.[1] The rapid population growth worldwide, in addition to the decrease in rural living areas and an increase in uncontrolled urbanization, has resulted in many people losing their lives in earthquakes, having to migrate to other settlements, infrastructure systems being adversely affected and irreparable economic losses occurring in the country.[2,3] Natural disasters such as earthquakes may cause death by direct destruction and indirect illness For individuals, the stress caused by the earthquake, the lack of hygiene due to the lack of access to clean water and food and sanitization, the lack of clean air due to collapsed buildings, injuries due to being trapped under debris can be considered the most important cause of infection, while electricity, water, damages in gas and sewerage networks and disruption of the supply chain are among the reasons that increase the likelihood of infection.[4,5] Moreover, during natural diseases the loss of medicines used by people, damage to hospitals and health facilities, and the decrease in emergency capacity despite the increase in the number of people in need of emergency intervention also affect medical treatment.[6] Throughout all these unfavourable conditions, the fact that people try to live in camp areas where there is insufficient living space, leads to a problem in their access to uncontaminated food and water, and a susceptibility to infection arises.[2] For this reason, increasing the surveillance of contagious diseases has an important place in the fight against post-earthquake infectious diseases and epidemics.[2]

If we look at all these stages in order, we need to divide the process of infection transmission into 3 parts. The first stage is the period when the individuals affected by the disaster are rescued and the first aid services are mainly carried out. In cases of infections that are found in tissues with impaired integrity, it is important to be careful. This period generally refers to the first 4 days of the process. The second period defines the initial month in which there is an increase in the frequency of infections from contaminated food and water and the incidence of droplet transmitted infections because of communal living. The third period is the period in which infections with a long latent period or incubation period are seen. Endemic diseases and epidemics specific to the disaster area can be seen. This is the period when infections are most common due to large human migrations, crowded living areas, excess stagnant water, difficulty in accessing clean water, inadequate hygiene, malnutrition, inadequate vaccination, and rapid increase in the number of vectors.[7]

In a meta-analysis that was perfromed, gastrointestinal and hepatic infections were shown as the most common infections (163.4 cases per 100,000 people). This was followed by dermal infections (84.5 cases per 100000 persons), respiratory tract infections (9.9 cases per 100000 persons), and central nervous system infections (0.5 cases per 100000 persons).[8] Infections that are encountered following the earthquake are summarized in **Table 1**.

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Tablo 1. Post-earthquake infections and their characteristics 14,15

Infections	Transmission	Pathogen	Clinic	Incubation Time
Wound Infections				
Tetanus	Wounds with contaminated with dirt, feces and soil	Clostiridium tetani	Difficulty swallowing, trismus	3-21 days
Skin and soft tissue infections	Bacterial colonization	Gram negative ve Gram positive bacteria	Fever, skin rash, myonecrosis, gangrene	1-14 days
Waterborne infections				
Gastroenteritis	Fecal/oral transmission	V. cholerae, Shigella dysenteriae,	Watery diarrhea, bloody diarrhea, nausea	12 hours -5 days
Leptospirosis		Leptospira spp.	Fever, headache, chills, myalgia	2-28 days
Hepatitis		Hepatitis A and E	Icterus, abdominal pain, nausea, diarrhea	15-50 days
Infections due to communal living spaces				
Viral URT	Droplet and contact	Influenza, COVID-19	Fever, myalgia, respiratory distress	1-14 days
Pneumonia		S. pneumoniae, H. influenza	Fever, cough, tachypnea	1-3 days
Measles		Rubeola	Fever, rash	10-12 days
Menengitis		N. meningitidis	Fever, headache, neck stiffness, altered consciousness	2-10 days
Tuberculosis		Mycobacterium tüberculosis	Cough, night sweats, fever, weight loss	12 weeks-3 years
Vector-borne infections				
Malaria	Mosquito	P. vivax	Fever, chills, myalgia	7-30 days

INFECTIONS LINKED TO IMPAIRED TISSUE INTEGRITY

Aside from the first diseases that come to mind such as tetanus, crush syndrome, which may include the crushing of tissues, edema in the muscles, kidney failure, heart failure, respiratory failure and shock can also be seen, especially due to the time spent under the debris and pressure.[9]

According to the recommendation guide prepared for the management of Crush syndrome, through the venous catheter which is to be opened while still under debris, initiation of isotonic sodium chloride at a rate of 1000 ml for adults and 15-20 ml/kg/hour for children for the first two hours, avoidance of crystalloids containing potassium (Ringer lactate, etc.); at the end of two hours, it is advised to reduce the maintenance dose by half.[10] The presence of infection accompanying Crush syndrome is associated with high mortality and morbidity.[9] In a study, it was shown that the mortality rate was 3 times higher in patients who developed sepsis due to an earthquake related wound.[4] Especially in earthquake victims, 81% of the fasciotomies performed due to compartment syndrome were shown to be infected, which confirms that it is also a risk factor for mortality.[4] The increase in the duration of stay under debris can also be considered a risk factor since it increases the risk of both pathogen exposure and the development of crush syndrome. Cases of organ failure and malnutrition that are seen in disaster survivors may predispose hospitalized patients to healthcare-associated infections.

Due to all these reasons, infection can be seen in 22.8% to 67.2% of the disaster victims. More than half of these infections are in the form of skin and subcutaneous infections seen in the areas of injury.

Especially in cases of crushing and injuries, the presence of necrotic tissue and foreign body causes bacterial colonization and ultimately infection. In a study, wound infections due to resistant Gram-negative bacteria were found most frequently.[9,11]

After the earthquake and tsunami in Indonesia in 2004, after the Pakistan earthquake in 2005, and after the great eastern Japan earthquake in 2011, there was an increase in cases of tetanus due to the lack of vaccination.[2,12]

In injuries related to collapses of infrastructures, a delay in starting care of the wound or immediate closure of the wound, can lead to the dvelopment of deep soft tissue infections. Gas gangrene is a part of the group of vital infections. Therefore, it is recommended to pay attention to proper wound care.

In the case of patients that are followed up in clinics, contact isolation is advised against resistant Gram-negative bacteria until the culture test results are clear.[11,13]

The bone, soft tissue and neurovascular statuses of the wounds should be evaluated, contaminated areas and areas of necrosis should be carefully cleaned, foreign bodies should be removed, and appropriate debridement should be performed.

The primary suture should not be rushed and should only be applied to properly cleaned wounds within the first 6 hours after injury.[11] In other wounds, additional debridements should be performed at the 48th hour of the wound occurrence, and closed once it is concluded that it is clean. Alongside wound care, it is also recommended to use systemic antimicrobials instead of topical antimicrobials as part of treatment.[13] For wounds without significant contamination and before closed fracture operations, a single dose of prophylactic antibiotic is recommended, whereas for open fractures and dirty wounds a 7-day treatment is recommended. Antibiotic prophylaxis is not recommended for injuries with intact skin.[4,11]

Tetanus

Tetanogenous wound; is defined as a star-shaped crushed wound older than 6 hours, deeper than 1 cm, containing a foreign body or necrotic tissue. Injuries with fractures are also risk factors for tetanus. For this reason, when evaluating the wounds of the victims, their vaccination status should also be evaluated. It is recommended to administer both the tetanus vaccine and tetanus immunoglobulin for those injured who have not had 3 doses of vaccine in the past or whose vaccination status is unknown. No additional recommendation is needed for those who have a full dose of vaccine and who have received a booster vaccine in the last five years, but a single dose of the vaccine is recommended for those who have not received a booster vaccine in the last five years.[4,11]

Infections Due To Lack Of Sanitization

In the case of developing countries, 40% of deaths in the shelter camps of disaster survivors are due to gastroenteritis.[14] In poorly planned and crowded camps, there may be an increase in enteritis cases due to the difficulty in the access to clean water as a result of damage to water networks, the lack of tools used to prepare food and cleaning materials such as soap to clean hands.[15] Studies have shown Salmonella enterica serotype paratyphi A, Vibrio cholerae, and norovirus as contributing factors in particular. For this reason, hydration is the most important treatment to be performed outside of health institutions.[2,16]

Following natural disasters, the problem of housing and open water resources causes an increase in contact of rodents such as mice with water, mixing of rodent urine with water, and consumption of food prepared with that water. As a result, there was an increase in leptospirosis cases. It has been reported that there may be an increase in hepatitis E and hepatitis A cases in cases where the sewage system and drinking water have mixed.[2]

Hepatitis A and hepatitis E

Although hepatitis A and E infections are associated with travel to endemic countries, they can lead to epidemics due to faecal contamination of drinking water and lack of sanitization after natural disasters such as earthquakes. The main approach should be supportive treatment. Both infections do not become chronic, but it should be kept in mind that hepatitis E may progress in a fulminant way in pregnant women.[17]

Cholera

It is a disease that is transmitted by consuming drinking water contaminated with faeces and can lead to an epidemic. While mortality is 50% in untreated cases, mortality decreases to 1% in treated patients. Severe cases should be followed up by hospitalization. Oral hydration is recommended in patients with good clinical status. Contamination can be prevented through safe and clean water sources and observance of personal hygiene rules.[18]

Leptospirosis

Spirochetes, which are found in the urine of many animal species including dogs, when mixed with water result in disease in humans. Preventing contact with contaminated water and fighting mice are methods to control the transmission of the disease.[18]

Typhoid

Typhoid is a febrile disease caused by Salmonella typhi, which is faecal-oral transmission as a result of faeces contaminating clean water. Especially after natural disasters such as earthquakes and tsunamis, epidemics can occur due to the decrease in clean water areas, restriction of access to antibiotics, and failure to comply with hygiene rules in public living areas. The most serious complications are bleeding and intestinal perforation.[19]

Infections Caused By Living In Communities

Especially in young children, acute respiratory disease (ARI) and pneumonia are responsible for approximately 20% of deaths. Valley fever and whooping cough are also among the diseases that can be seen following an earthquake.[20] Lack of clean water and personal hygiene, and housing problems leading to close contact between individuals can be considered as causes of this situation.[21]

There is an increase in the frequency of diseases transmitted by other droplets in places where large groups live together where ventilation conditions are poor, and nutrition and shelter conditions are not provided. There is also an increase in cases of rash diseases such as measles and chickenpox, and meningitis due to N. meningitidis.[2,3]

In situations where there is both a lack of hygiene and personal items such as sheets, towels, mattresses and slippers, the incidences of ectoparasites such as scabies increases.[8]

Meningococcal Meningitis

In cases related to N. Meningitidis affecting children, young adults and individuals living in communities, the meningitis agent transmitted by droplets can be seen. If possible, these cases should be isolated and those who encounter these cases should receive chemoprophylaxis with ceftriaxone, rifampicin or ciprofloxacin.[22]

Scabies

In areas where personal hygiene rules are not followed, Sarcoptes scabiei infestation can be seen since people are in close contact to each other for a long duration of time and communal toilets are not cleaned. However, it should be kept in mind that the transmission is not due to short-term contact such as shaking hands, but rather to long-term contact and the use of communal materials.[23]

Measles

It is a rash disease with a high mortality rate, especially in children. At the beginning of the epidemic, a rapid vaccination program should be carried out to cover all individuals in society, including 6-month-old babies. In epidemics that occur during disasters, it is not recommended in practice, as there is not enough space to carry out isolation and quarantine practices in such situations.[18]

Viral Upper Respiratory Infection (URTI)

After the earthquake, people living collectively in areas without proper ventilation conditions, the drinking of contaminated water, as well as inadequate personal hygiene practices are predisposing factors for contracting viral upper respiratory tract infections.[24]

Especially in seasons with a temperature difference between day and night, viral exacerbation may be diagnosed more frequently within a month following the earthquake.[25]

Latent Infections

Occurring in the late period following the disaster; there has also been an increase in tuberculosis cases due to delays in diagnosis due to immigration, disruption in drug supply, or inadequacy of healthcare providers.[8]

Tuberculosis

This spread of this disease is seen due to migration from endemic areas and due to collective living areas. It can be controlled by facilitating access to medication for individuals receiving treatment with directly supervised treatment and the screening of individuals that have been contacted by the disease.[26]

Vector-Associated Infections And Zoonoses

As a result of the increase in the number of mosquitoes, there may be an increase in diseases with high fever such as dengue fever, malaria, and leishmaniasis in endemic areas. For example, one-third of the cases reported in Asia occurred in the Iran earthquake.[20,28] Therefore, necessary precautions should be taken according to the regional and climatic conditions.

Malaria

Malaria is a disease that is transmitted through the bites of Anopheles mosquitoes in endemic areas and is characterized by seizures of chills with accompanying fever. In addition to personal measures such as the use of insecticide-treated bed nets and fly repellent, regional measures such as the prevention of swamp formation and stagnant water should also be taken.[29]

Precautions

Access to clean water, proper toilet and sewer infrastructure, and ensuring food safety can aid in the prevention of Gastroenteritis.[4] Information should be provided on proper hand washing and personal hygiene practices, before and after eating, following sneezing and coughing, information should be given on washing with soap and water or rubbing with alcohol-containing solutions.[30] For drinking water, primarily closed and bottled water should be preferred. Boiled then chilled water or water disinfected with bleach are other alternatives. Three drops of conventional household bleach containing 4% chlorine provides sufficient chlorination for each 1 litre of water, and vegetables and fruits can be washed with this water.[15]

It is recommended that the bodies of those who lost their lives in the earthquake be buried one by one in recommended areas with local guidelines.[30] It is recommended to wear a mask to cover the mouth and nose, especially in closed areas, to use tissue paper when coughing and sneezing if possible, and to maintain a distance of 1-2 meters from people with symptoms of upper respiratory tract infection.[2] In patient care, masks should be used in combination with other measures such as hand hygiene and physical distancing to be effective in preventing the spread of infections and if possible, for caregivers, it is recommend to follow local vaccination guidelines and prioritize vaccines that are most relevant to the specific setting and population.[31] Considering that the standard resources in the affected areas may be insufficient, planning should be made by local authorities, healthcare providers, and communities for the transportation of the necessary medical equipment and materials for infection prevention and treatment.[32] It is recommended to prioritize strengthening existing healthcare systems and building local capacity to respond to disasters and other emergencies.[33]

The correct choice of shelters, their proximity to sources of water, access to clean water and sanitization, removal of garbage and other wastes with appropriate methods, and combating mosquitoes can prevent the spread of diseases that can be transmitted by vectors. In addition to this, it is recommended that pest control is carried out regularly.[34] In order to prevent the spread of zoonotic diseases such as rabies and brucellosis, it is necessary to do animal vaccinations, quarantine zones should be established if necessary, and the gathering of healthy animals and sick animals should be prevented.[30]

CONCLUSION

In order to prevent infectious diseases in the earthquake area, it is necessary to comply with hygiene conditions, give importance to sanitization, use appropriate personal protective equipment, give priority to vaccination and act in line with the recommendations of local public health authorities.

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